

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 779 695 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

18.06.1997 Bulletin 1997/25

(51) Int Cl.<sup>6</sup>: H02K 1/27

(21) Application number: 96308104.7

(22) Date of filing: 08.11.1996

(84) Designated Contracting States:

DE FR GB IT

(30) Priority: 14.12.1995 GB 9525545

(71) Applicant: ROLLS-ROYCE POWER

ENGINEERING plc

Newcastle-upon-Tyne NE3 3SB (GB)

(72) Inventors:

• Mitcham, Alan John

Ponteland, Northumberland NE20 9LJ (GB)

• Prothero, David Huw

Cramlington, Northumberland NE23 6EJ (GB)

• Grime, Colin John

Culcheth, Cheshire WA3 4LL (GB)

(74) Representative: Barcock, Ruth Anita

Rolls-Royce plc,

Patent Department,

P.O. Box 31

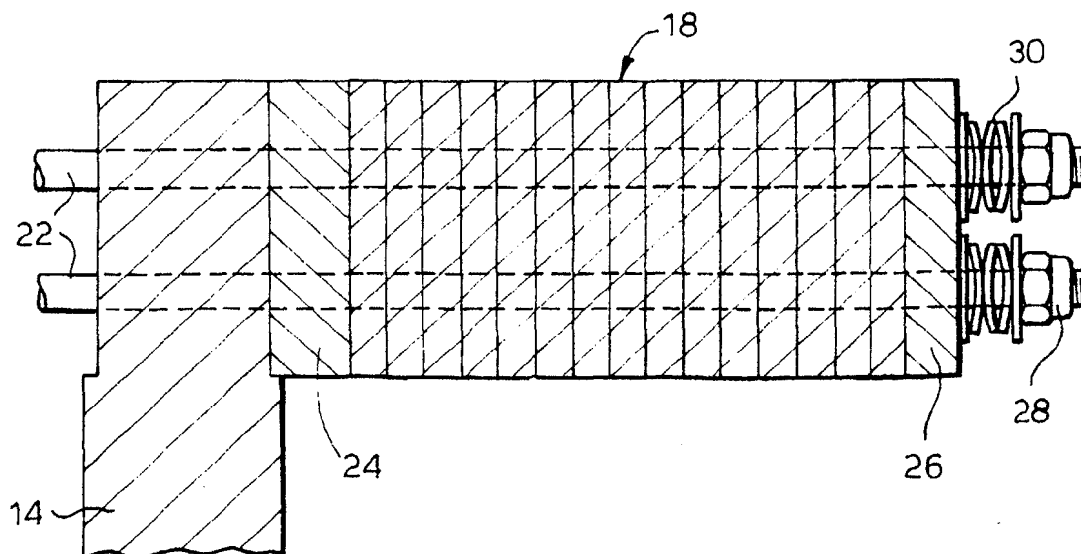
Derby DE24 8BJ (GB)

(54) Rotor disc

(57) A rotor disc (14) for use in an electrical machine (10) has circumferential rotor rims (16) mounted thereon. The rotor rim (16) comprises a row of alternate magnets (20) and laminated pole pieces (18). Each laminated pole piece (18) is supported on two electrically insulated through bolts (22). A compressive force is applied

to the stack of laminations via two rings (24 and 26). The outer ring (26) is tightened down by nuts (28) and washers (30). The washers (30) are resilient so that the correct compressive force is maintained regardless of relaxation in the lamination stack and differential expansion of the rotor components.

Fig.3.



EP 0 779 695 A1

## Description

The present invention relates to a rotor disc for use in an electrical machine and in particular to the construction of an active rim on the rotor disc.

Electrical machines which operate in accordance with transverse flux principles consist of an armature winding in the form of a circular coil co-axial with a rotor. The rotor consists of an active rim comprising a multiplicity of magnets and laminated poles, fastened to a rotor disc. The armature winding links the flux generated by the permanent magnets mounted on the rim of the rotor disc by means of a series of stator cores.

The rotor disc may support several rotor rims typically arranged in pairs on opposite sides of the disc. Each rotor rim is circumferential and may consist of a single row of magnets and laminated pole pieces or a double row separated by an insulated spacer.

Smaller transverse flux motors use a combination of through bolt clamping of the pole laminations and gluing of the magnets. These motors produce relatively little torque and the transfer of torque to the rotor disc is achieved mainly by shear and bending effects in the through bolts.

For larger transverse flux motors the forces are taken predominately by bending in the lamination stack.

A rotor disc in accordance with the present invention seeks to provide a rotor rim having improved integrity, the pole pieces of which can withstand forces without significant deflection.

According to the present invention a rotor disc for use in an electrical machine has at least one circumferential rotor rim mounted thereon, the rotor rim comprises at least one row of alternate magnets and laminated pole pieces, the laminations in each pole piece being supported by at least one bolt which extends through the rotor disc, means being provided on the bolt for compressing the laminations characterised in that the means for compressing the laminations is resilient to maintain the correct compressive force on the laminated pole piece throughout operation.

Compressing the laminations gives the pole pieces the required structural stiffness and the resilience ensures maintenance of the correct compressive force on the laminated stack throughout operation.

Preferably the means for compressing the laminations are nuts, the resilience being provided by sprung washers which may be belleville washers.

The present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a transverse flux motor having a rotor constructed in accordance with the present invention.

Figure 2 is an enlarged view of part of one of the rotor rims shown in figure 1 having laminated pole pieces.

Figure 3 is an enlarged cross-sectional view through one of the laminated rotor poles shown in figure

2 compressed in accordance with the present invention.

Referring to figure 1 a transverse flux motor, generally indicated at 10 comprises a rotor and a stator assembly.

The rotor assembly has four rotor discs 14 bolted to flanges 13 on a hollow shaft 12. Each disc 14 has four circumferential rotor rims 16 which support the active rotor components for four motor phases.

Each rim 16 consists of a single row of alternate pole pieces 18 and permanent magnets 20. Suitable magnet materials are the high energy rare earth magnet materials such as samarium cobalt and neodymium iron boron.

The pole pieces 18 are laminated, figure 2, and bolt holes 21 are provided through the stack of laminations. Bolts 22 shown in figure 3 pass through the bolt holes 21 to hold the stack together.

Each laminated pole piece 18 is supported on two bolts 22, figure 3. The bolts 22 are electrically insulated and are fastened to the rotor disc 14.

A compressive force is applied to the laminated pole piece 18 via two annular members 24 and 26 made from glass reinforced plastic. The outer annular member 26 is tightened down using nuts 28 and a number of sprung washers 30.

The compressive force on the laminations gives the pole piece 18 the required structural stiffness to minimise deflections when in operation. By compressing the laminated stack it prevents one edge of the pole piece 18 coming into tension as torque is transmitted to the rotor disc 14.

The sprung washers 30 are resilient so that the correct compressive force is maintained on the pole piece 18 regardless of relaxation in the stack of laminations and differential expansion of the rotor components. Retaining the compressive force on the lamination stack maintains the required structural stiffness and minimises deflections in the pole piece 18 when in operation.

It will be appreciated by one skilled in the art that the sprung washers 30 could be helical or belleville washers. Alternatively the washers 30 could be manufactured from a material which is sufficiently resilient to compensate for differential expansion or relaxation in the lamination stack.

## Claims

1. A rotor disc (14) for use in an electrical machine (10) has at least one circumferential rotor rim (16) mounted thereon, the rotor rim (16) comprising at least one row of alternate magnets (20) and laminated pole pieces (18), the laminations in each pole piece (18) are supported by at least one bolt (22) which extends through the rotor disc (14), means (28,30) being provided on the bolt (22) for compressing the laminations characterised in that the means (28,30) for compressing the laminations is

resilient to maintain the correct compressive force on the laminated pole piece (18) throughout operation.

2. A rotor disc (14) as claimed in claim 1 characterised in that the means for compressing the laminations are nuts (28) and sprung washers (30). 5
3. A rotor disc (14) as claimed in claim 2 characterised in that the sprung washers (30) are belleville washers. 10

15

20

25

30

35

40

45

50

55

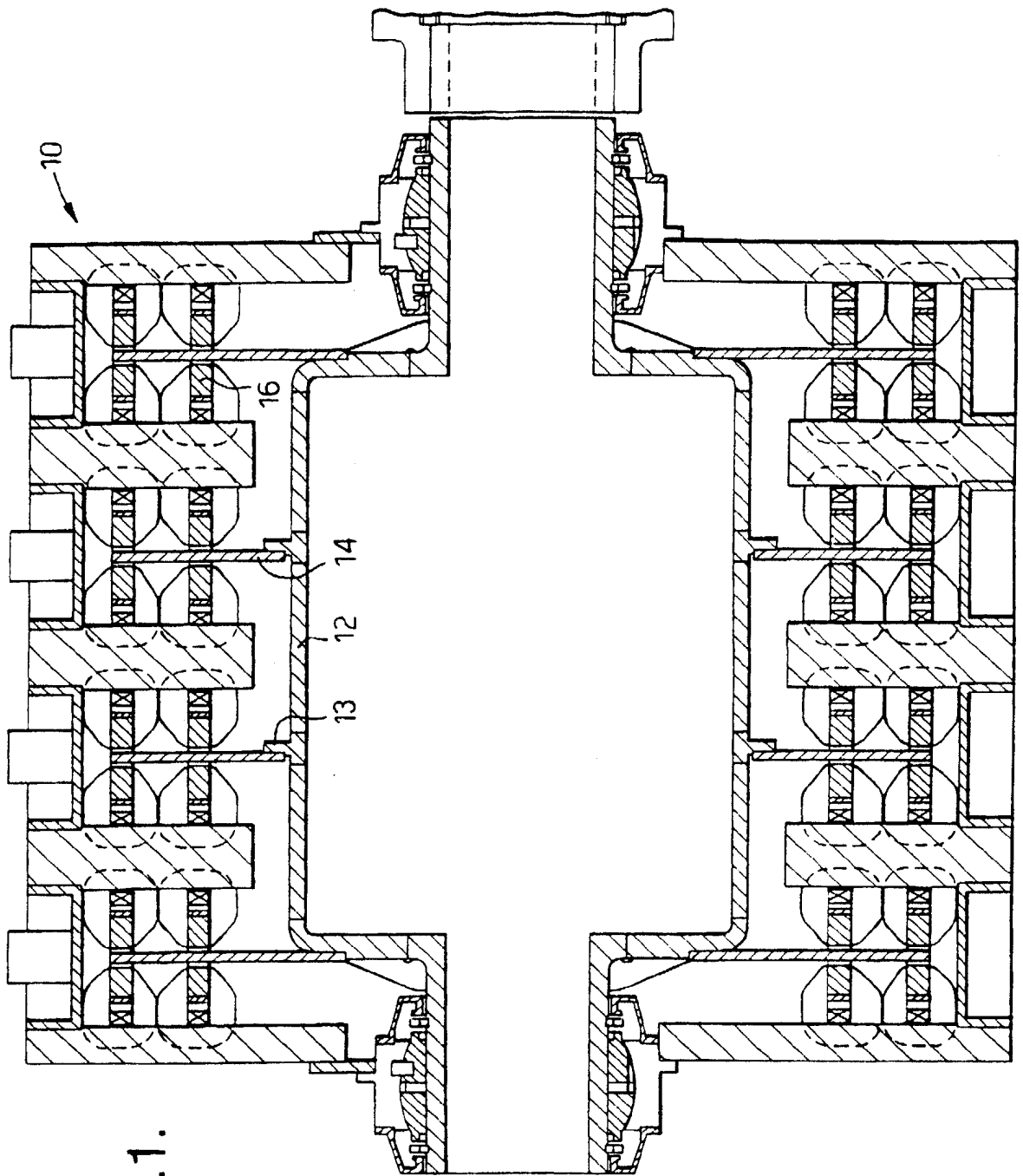


Fig.1.

Fig.2.

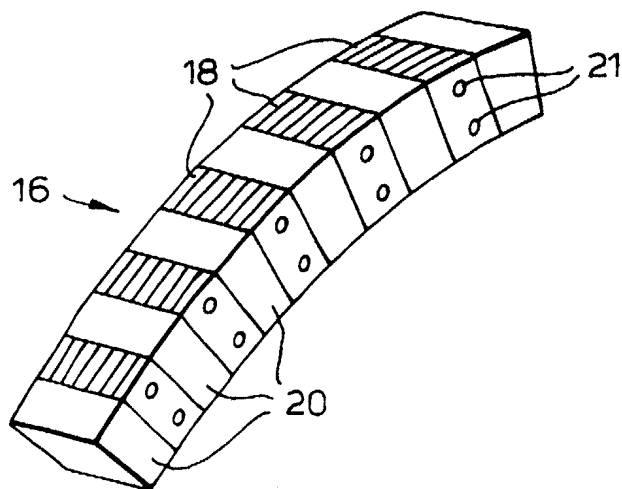
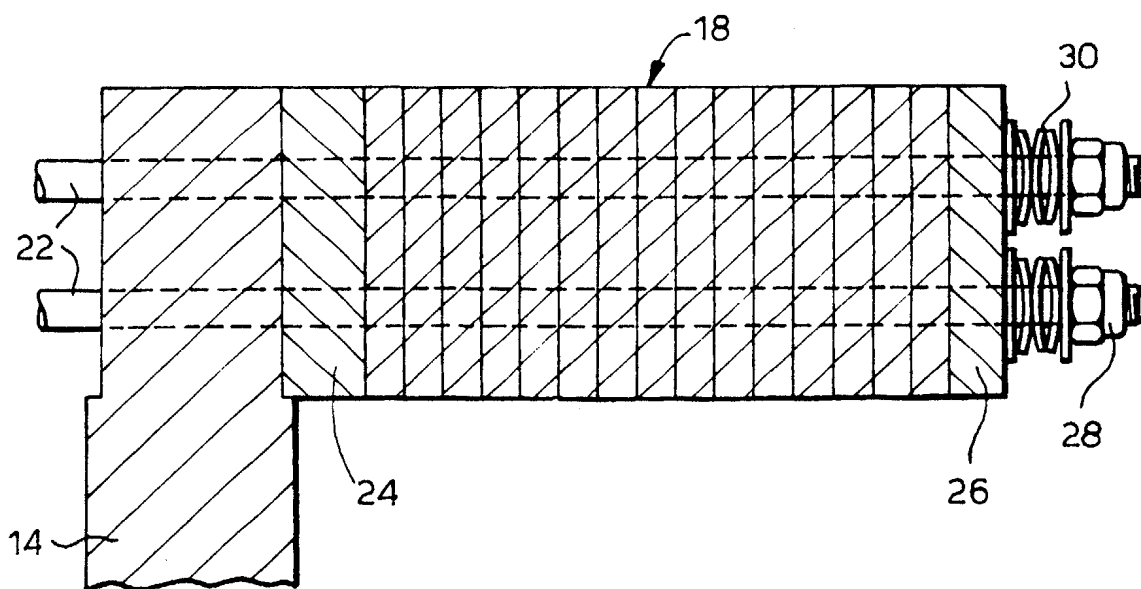


Fig.3.





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 96 30 8104

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE 43 30 272 C (VOITH GMBH J M) 8 December 1994 * column 4, line 27 - line 53; figures 1,2 * ---	1	H02K1/27
A	GB 2 159 340 A (DSO ELPROM) 27 November 1985 abstract * figure 1 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H02K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 March 1997	Examiner Zoukas, E
CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application I: document cited for other reasons &: member of the same patent family, corresponding document			

EPO FORM 1501 (01.92) (P/M/C/D/I)